THE WHANGAMATA WHARF SITE (N49/2): EXCAVATIONS ON A COROMANDEL COASTAL MIDDEN

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Abstract. Excavation of a coastal midden at Whangamata, Coromandel Peninsula, New Zealand, revealed two cultural layers separated by a wide band of sterile sand. Artifacts are described, and faunal remains are analysed with particular reference to the diet of the site's occupants.

Whangamata is a popular holiday resort on the east coast of the Coromandel Peninsula. It lies on an extensive sandspit between a large tidal estuary and a long ocean beach. The narrow mouth of the estuary is at the north end of the ocean beach and it is on the northern tip of the sandspit, along the southern shore of the estuary mouth, that extensive archaeological evidence has been revealed, both by marine erosion, and by development of properties near the shore.

The Whangamata wharf site, excavated by the author in August 1969, is situated on the foreshore immediately east of the modern wharf (Fig. 1). Here the foreshore is eroding as a result of wind and sea action, exposing a layer of shell midden near the top of the sloping sandy beach. A thin lower layer, containing obsidian and dog bone, which was eroding out further down the beach towards the high tide mark, had been discovered by Mr. R. G. W. Jolly and at various times during the previous few years Mr Jolly and other visitors to the area had made collections of material from this eroding edge.

The "wharf site" is probably part of a much larger site spread over an area of two or three acres, and now dissected and interrupted by recent sand dunes, roads and houses. Excavations at the Cabana Lodge flats, a short distance from the wharf site, by the owner, Mr East, and Mr R. G. W. Jolly, have revealed an associated flaking floor and fishhook manufacturing level. Rich in artifacts, the Cabana Lodge site seems to belong to the Archaic phase.

Bands of midden and occasional flakes are revealed in the eroded beach frontage along the estuary for several hundred yards north-west of the wharf site. It seems that these cultural remains are heterogeneous, perhaps widely separated in time, since a small excavation by Mr F. W. Shawcross on the bank immediately above the beach a little to the west of the wharf site, and just across the road from the Cabana flats, revealed a different assemblage of artifacts (basalt flakes, Classic Maori artifacts) from that of the wharf site (Shawcross 1964).

At the present day there are large quantities of soft shore shellfish on both estuarine and ocean beaches, in spite of intensive gathering by residents and holiday makers. In the muddy sands of the estuary are found cockles *(Chione*

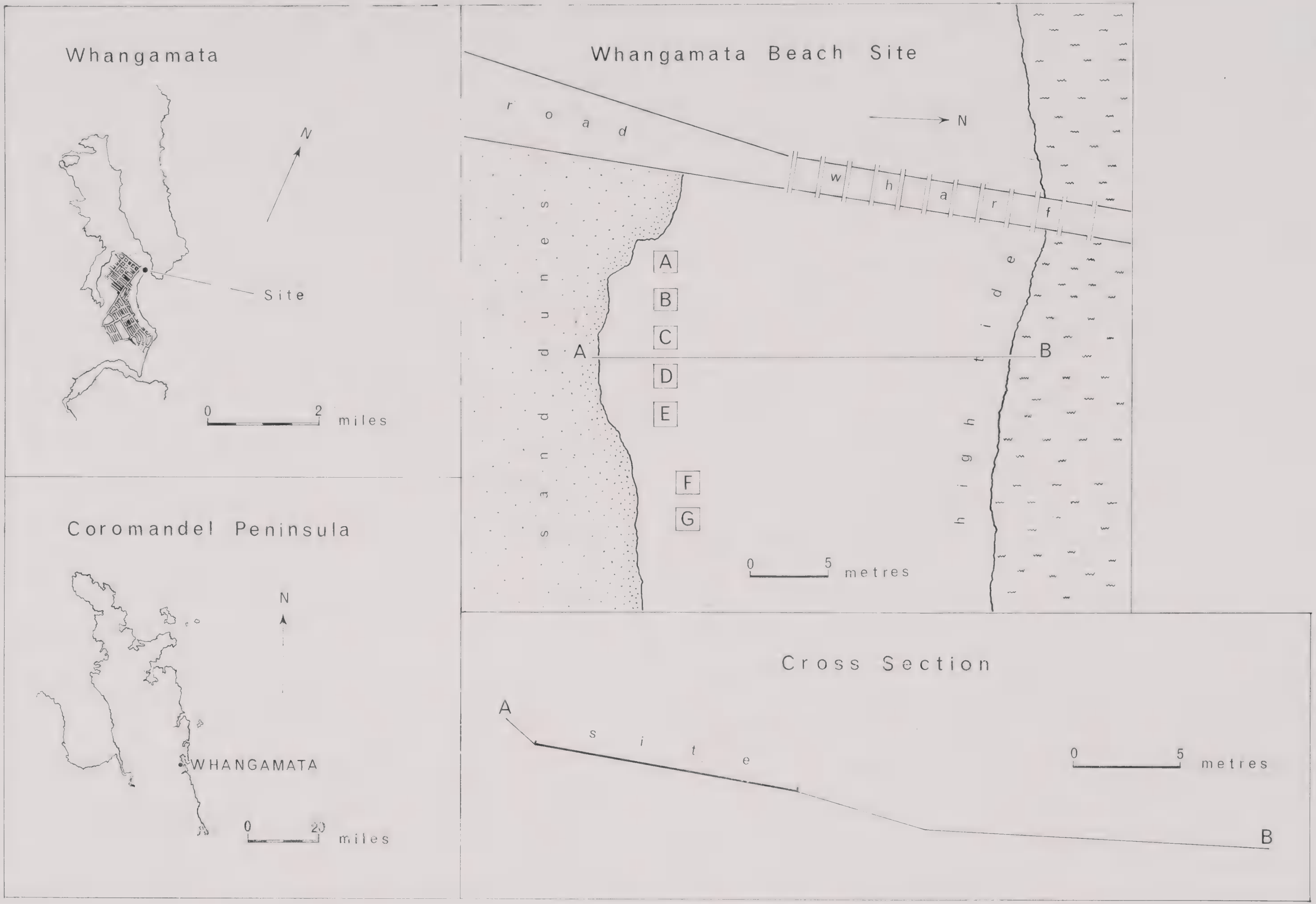


Fig. 1. Location and plan of the Whangamata wharf site, N49/2.

PART of SOUTH BALK

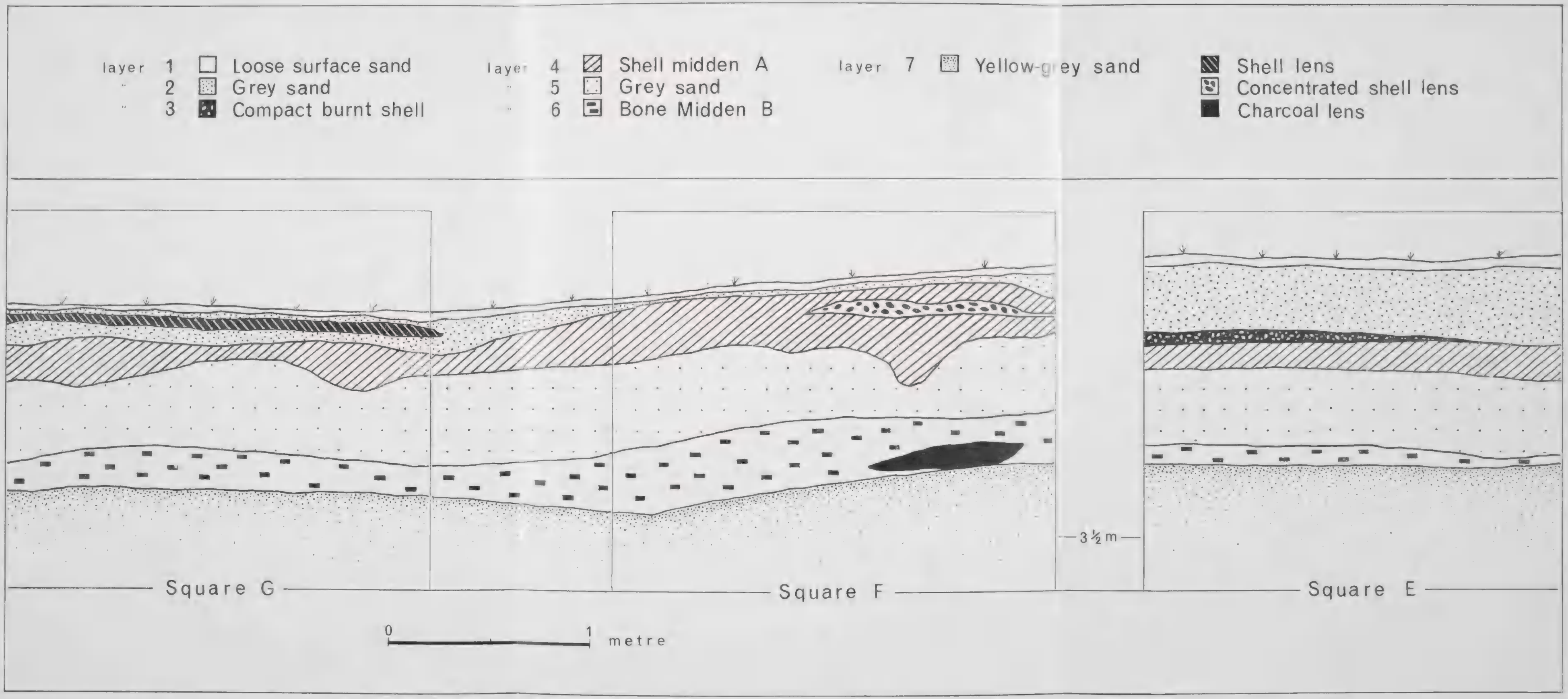


Fig. 2. Principal cross-section, N49/2.

stutchburyi) and pipi *(Amphidesma australe)* while the ocean beach is rich in tuatua *(A. subtriangulatum).* Since both estuarine and ocean beach shellfish are found in close proximity to the site, any marked preference for either type is presumably the result of cultural choice rather than environmental exigency. Beds of rock oysters *(Crassostrea glomerata)* and other gastropods are found on the rocky shore opposite the site.

Today there is no fresh water less than a mile from the site, except a permanent stream flowing into a waterfall at the cliffs on the other side of the estuary. Some of the older residents of Whangamata had heard descriptions of the early settlers rowing across the estuary to fetch fresh water. This may also have been true of Maori occupants, in early European times at least, since barrel hoops were found in the upper layer of the midden.

The excavation was restricted to the narrow strip between the high tide mark and the dunes which protect the foreshore from wind erosion. The excavation was set as far back towards the edge of the dunes as was practicable, to avoid the more eroded and thus disturbed area of the site closer towards the water. Seven 2 m squares were set out parallel to the edge of the beach. Squares A to E were separated by 1 m baulks. Squares F and G were slightly further forward and separated from the other squares by a gap of 3.5 m (Fig. 1). The squares were divided into quadrants. In this way it was hoped to localise, as far as was practicable, all bone and shell material. The site was excavated with hand trowels according to natural layers, and total collection of both bone and shell was carried out.

Stratigraphy

The Whangamata wharf site contained two main occupation layers: a thick band of shell midden (termed Midden A) and beneath it, and separated from it by a metre of sterile sand, a second layer of midden (Midden B), containing bone rather than shell (Fig. 2).

Midden A was relatively homogeneous, although interspersed with *haangi* and in square G interrupted by a lens of sand. It contained intermingled European and Maori artifacts. The lack of any obvious demarcations within the midden seems to imply that it was formed during a single semi-continuous occupation of the site, dated (from the European evidence) at *ca.* 1870 (see p. 67).

In squares D and E an interesting hard trampled floor of shell, charcoal and sand (layer 3) lay immediately above Midden A. This was obviously a much-used area—possibly a centre of cooking activity, since there were several associated *haangi,* although there was no evidence of structures. There were no associated artifacts, thus only a *terminus post quem* of 1870 can be established. However, the apparent association of layer 3 with the traditional Maori way of life, and the fact that it lay immediately above Midden A with no intervening sand layer, make it probable that it too belongs to the nineteenth century.

Between layer 3 and the surface were small pockets of midden, without cultural associations and therefore of unknown date. Some at least may be of modern origin, and they are therefore not included in the site midden analysis.

Midden B contained the bone of an immature moa (probably *Euryapteryx gravis*), a one-piece fishhook, and an unfinished broken adze, apparently of Type 3 in Duff's (1956) classification. Midden B, therefore, appears to belong to the Archaic phase. Radiocarbon samples were collected from this layer but have not been submitted for analysis.

A 4 m deep test pit was dug in square D, extending nearly 2 m below Midden B, without revealing any further cultural remains. It would seem, therefore, that Midden B represents the earliest occupation of the site.

Artifacts

FISHING GEAR

Two tabs made from whale rib were found in Midden A, both from the same square (D), immediately below a concentration of nails and glass. Both tabs suggest an early stage in manufacture of one-piece hooks. One showed gouging or "pecking" on the upper surface; the other was much larger and showed evidence only of preliminary shaping (Fig. 3).

Figs. 3, 4. Fishing gear, N49/2. 3. Bone tab, Midden A. 4. Fragments of one-piece fishhook from Midden B.

Pieces of an unbarbed one-piece fishhook with a flat-topped backward pointing head (Fig. 4) were found in Midden B (square A). There was some roughening of the inner surface of the shank, either very crude serrations or, as appears more likely, the marks of rat teeth.

The presence of a one-piece fishhook is consistent with other indications that Midden B dates from the Archaic phase. The whale bone tabs in Midden A seem to be anomalous, however, firstly because the manufacture of one-piece fishhooks (of which the tabs are a preliminary stage) seems to be rare in the Classic phase

(Hjarno 1967), and secondly because the presence of bone fishhook tabs seems inconsistent with the presence of 19th century artifacts, which were found in the same layer. However, the deep layer of sterile sand that lay between Middens A and B seems to preclude the movement of artifacts from one layer to the other. (There were no signs of artificial disturbance.) Midden A does seem to be fairly homogeneous, belonging to a single occupation period.

It is almost certain that European fishhooks were available to the Whangamata Maoris in the latter half of the 19th century. They were early introduced as trade goods, and were prized by the Maoris, although not as much as firearms and iron hoes and axes.

Marsden and his fellow missionaries were accustomed to taking fishhooks as well as other small articles on their journeys as presents for the Maoris, and Kendall wrote in 1821: "They esteem fish-hooks as equal in value to our copper, axes and hoes to our silver, and muskets and powder to our gold." (Elder 1934, p. 173).

Presumably, then, these tabs, apparently indicating traditional bone fishhooks, as well as the other Maori tools, were present in the midden either because of a certain conservatism among the Maoris which conflicted with the desire for more efficient and durable tools; or else because the Maori production of goods acceptable to European traders was insufficient to finance the complete replacement of Maori by European technology.

ADZES

The blade of a small rough-out (8.2 cm long) was found in Midden B, square F (Fig. 5). It seems to be of triangular cross-section with apex downwards (Duff's type 3). This type is uncommon in New Zealand sites.

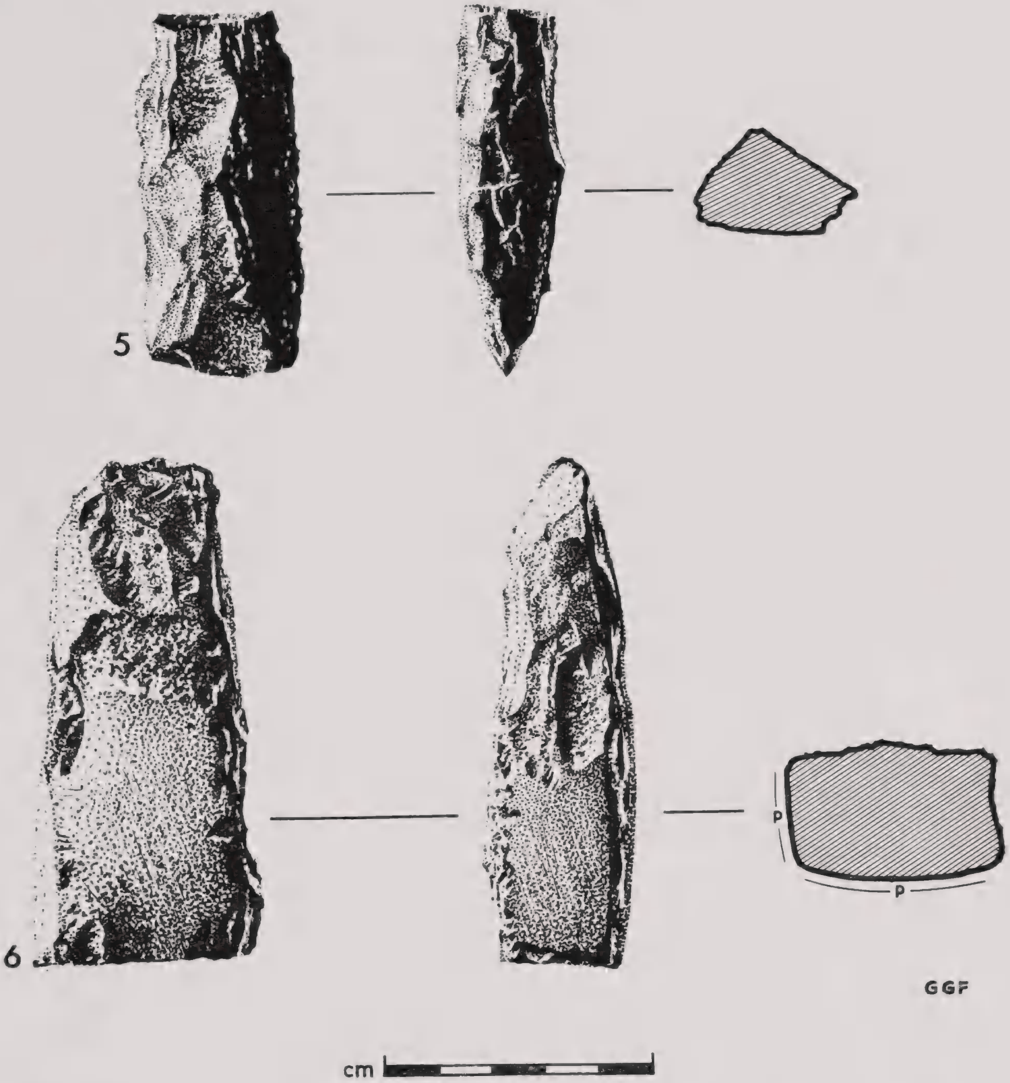
The butt of a larger adze was found in Midden A. It has a rectangular cross-section with very square cut sides, and narrows only slightly towards the poll. The front and sides are ground; the back is roughly flaked (Fig. 6).

FLAKES

Obsidian flakes were found in close association with scattered dog bones in Midden B. Figure 7, which shows the distribution of obsidian flakes, indicates clearly that most of them came from the Archaic layer. They are probably functionally connected with the dog bones, being used for butchering dogs or preparing their skins.

The flakes were measured (length = surface perpendicular to striking platform) and carefully observed for signs of use. It is evident from Figure 8 that flakes tended to be greater in length than breadth; in only 4 out of 86 was width greater than length. Thirty-one percent of the flakes had a length more than twice the width, while 7% had a width three times greater or more than the length. To what extent this tendency was the result of deliberate human action aimed at a particular template, and to what extent it was dictated by the nature of the material, is difficult to ascertain.

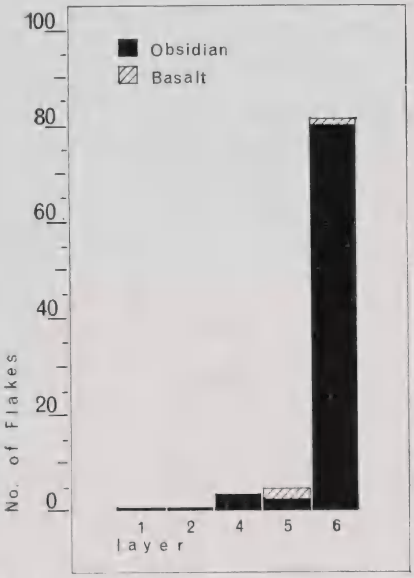
The presence of seven large cores, two quartzite hammer stones, and 171 tiny chips all less than 2 mm long, indicates that the flakes were prepared on the spot.

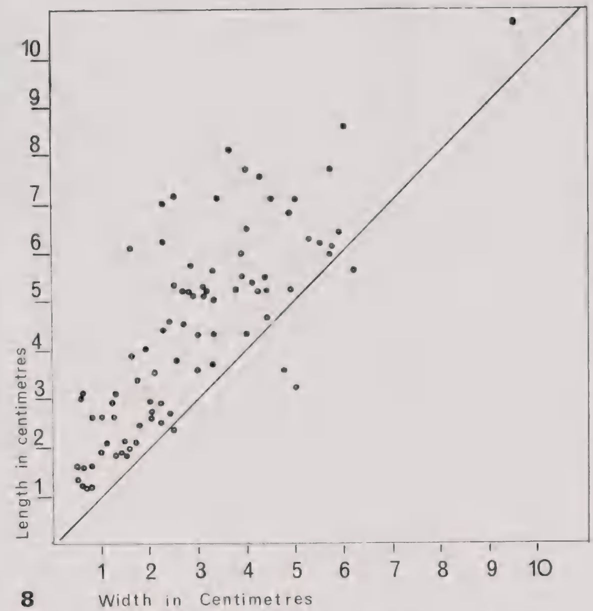


Figs. 5, 6. Adzes, N49/2. 5. Adze roughout from Midden B. 6. Butt of adze from Midden A.

A cache of obsidian flakes was found, containing 49 flakes and 3 cores; four of the flakes had apparently been used as end scrapers (shown by chipping and signs of wear on the relevant cutting edge), while ten flakes had been used as side scrapers. Of the flakes not in the cache three showed signs of use as side scrapers and two as end scrapers (Figs. 9 - 11).

Most of the obsidian in the site was of a dark grey colour, fairly opaque, with a greenish tinge, and is presumably from Mayor Island. Interestingly, however, the obsidian in the cache was not of this type, but was a clear grey colour with darker grey flecks.





7 8

Figs. 7, 8. Flakes, N49/2. 7. Distribution of obsidian and basalt flakes by layer. 8. Dimensions of obsidian flakes.

The presence of waterworn obsidian pebbles and boulders on the rocky shore opposite the site seems to indicate a hitherto unrecorded obsidian source (cf. Green 1964). This obsidian is grey and much of it contains spherulites. Some, however, is of flake quality, and some of the obsidian in the site may be derived from this source. In general, the local source would be capable of providing only small flakes, and obsidian for larger flakes would have to be sought further afield.

In contrast with many other middens on the Coromandel Peninsula, this site contained very few basalt flakes (Fig. 7).

EUROPEAN

A wide variety of European artifacts was found in Midden A and in the sandy layer between Midden A and the surface. Those within Midden A included pieces of melted lead (possibly reduced for sinkers), pipe stems, assorted iron and copper nails, beads, window and bottle glass, metal and pearl buttons and fragments of domestic earthenware and china. The last three categories obviously imply settled European residence at Whangamata, which in turn gives some indication of the age of Midden A.

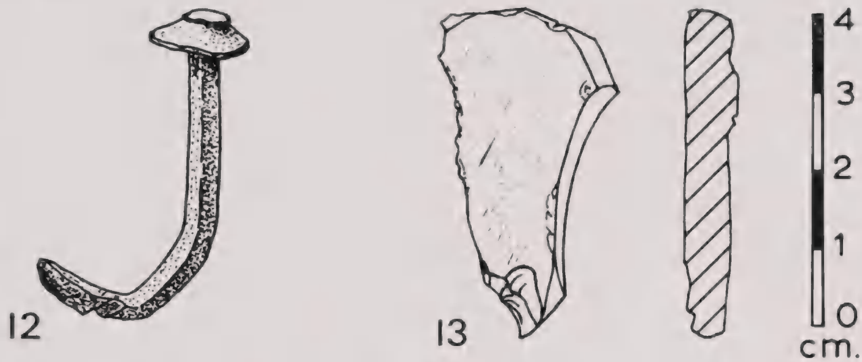
Although the Coromandel Peninsula was a venue for trading and whaling ships from the early 1800s there are no specific records of such ships calling at Whangamata. An early record of Europeans at Whangamata is in the census report of 1876 which records the presence of 41 Europeans there, mostly employed at a small timber mill which was probably established some time between 1868 and 1876, in response to the Thames gold rush.

There was also a pipe stem in the midden which could not have been manufactured before the 1860s. On the other hand, there are no articles of modern manufacture; the bottle glass, for example, comes from hand-blown bottles.

Figs. 9-11. Scrapers, N49/2. 9. Obsidian scraper, Midden B. 10. Obsidian scraper, Midden B. 11. Obsidian scraper, Midden B.

OTHER

The use of European materials in the manufacture of traditional Maori implements is rare in New Zealand. Of particular interest, therefore, were four artifacts made from European materials. A bronze nail seems to have been bent into a fishhook shape and a barb cut at the point (Fig. 12). Three fragments of thick bottle glass, all about 4 cm long, seem to show deliberate flaking at one end, and in one case, also on the side. They were probably used as drill points (Fig. 13). These artifacts are consistent with the apparent association of European and traditional Maori artifacts in Midden A, implying a transitional stage where traditional Maori artifacts were still being made, but were in the process of being replaced by European goods and materials.



Figs. 12, 13. Artifacts from European material, N49/2. 12. Worked nail from Midden A. 13. Flaked piece of bottle glass from Midden A.

Midden Analysis

Only in the last few years of New Zealand archaeology has use been made of the knowledge that food debris in middens reflects just as much culturally determined human choice as the artifacts made by man. The study of midden material provides a description, not only of foods eaten and their relative importance, but also of the society which organised its economic activity to obtain these foods, and of the culture of which that society was a part.

The bone and shell material in the midden was therefore analysed, identified, and in order to gain a standard of comparison by which to establish the relative economic importance of different food, converted to approximate meat weights.

SHELL

Method of analysis

In processing the shell material, it was first sieved on the site, then, after being transported to the laboratory, dried and sieved again. The midden in each layer in each quadrant was then sorted into species and weighed.

A major problem in sorting the shell material was its extreme fragmentation. To facilitate the sorting of such a large quantity of midden (over 300 kg) only whole shells of the three main species or those fragments with a hinge were sorted into species (Group A). The small number of gastropods and bivalves of other species were also classified into species. This left a large bulk of unidentified fragments without a hinge (Group B), all of which belonged to one of three species: *Chione stutchburyi, Amphidesma australe* or *Amphidesma subtriangulatum.* To project the species proportions of Group A fragments from a particular layer onto those of Group B would of course assume that the fragmentaticn rate of the three species was equal, which would probably not be true, since *Chione* has a more delicate shell than *Amphidesma.*

Thus to establish the rate of fragmentation of *Chione,* as opposed to *Amphidesma,* the total midden material from three quadrants of Midden A (from each end and the middle of the site) was sorted into Group A or Group B fragments, and within these groups into *Amphidesma* and *Chione*. The difference in species proportions between the two groups presumably reflects different rates of fragmentation. Results are shown in Table 1.

Table 1. Fragmentation of *Chione* and *Amphidesma* in three quadrants of Midden A.

QUADRANT	GROUP A			GROUP B			DIFFERENCE
	Chione (g)	*Amphidesma* (g)	ratio	*Chione* (g)	*Amphidesma* (g)	ratio	
A1	4755	2288	48:20	1825	415	88:20	2.1
C4	575	577	20:20	1863	718	52:20	2.4
G1	550	715	15:20	3425	1825	38:20	2.5

It can be seen that the difference in the ratio between Group A and Group B fragments is fairly consistent, indicating that *Chione* disintegrated at a uniform rate of approximately 2.4 times the rate of *Amphidesma.* Thus the Group B fragments were divided into species according to the following ratio.

If weight of Group A fragments *Chione* = X
And weight of Group A fragments *Amphidesma australe* = Y
And weight of Group A fragments *A. subtriangulatum* = Z
Then Group B fragments = 2.4X : Y : Z.

After the weights of each species for each layer were established, the results were reduced to percentages of the total weight, to find the relative importance of each species in the prehistoric economy. Obviously this was of great importance in a site such as Whangamata, where two separate marine environments were available to the inhabitants.

Results

Nearly all the shell (99.4%) came from Layer 3 (8%) and Midden A; there was almost no shell in Midden B (0.6% of total).

Figure 14 shows the relative distribution (by weight) of the shell species in Layer 3, Midden A and Midden B (omitting the shell lenses above Layer 3, of uncertain age). It is obvious that throughout the occupation of Whangamata, estuarine shellfish were preferred to those of the rocky shore or ocean beach. The lack of rocky shore shellfish is to be expected, since their collection would involve a canoe trip to the other side of the estuary. In any case, even if such voyages

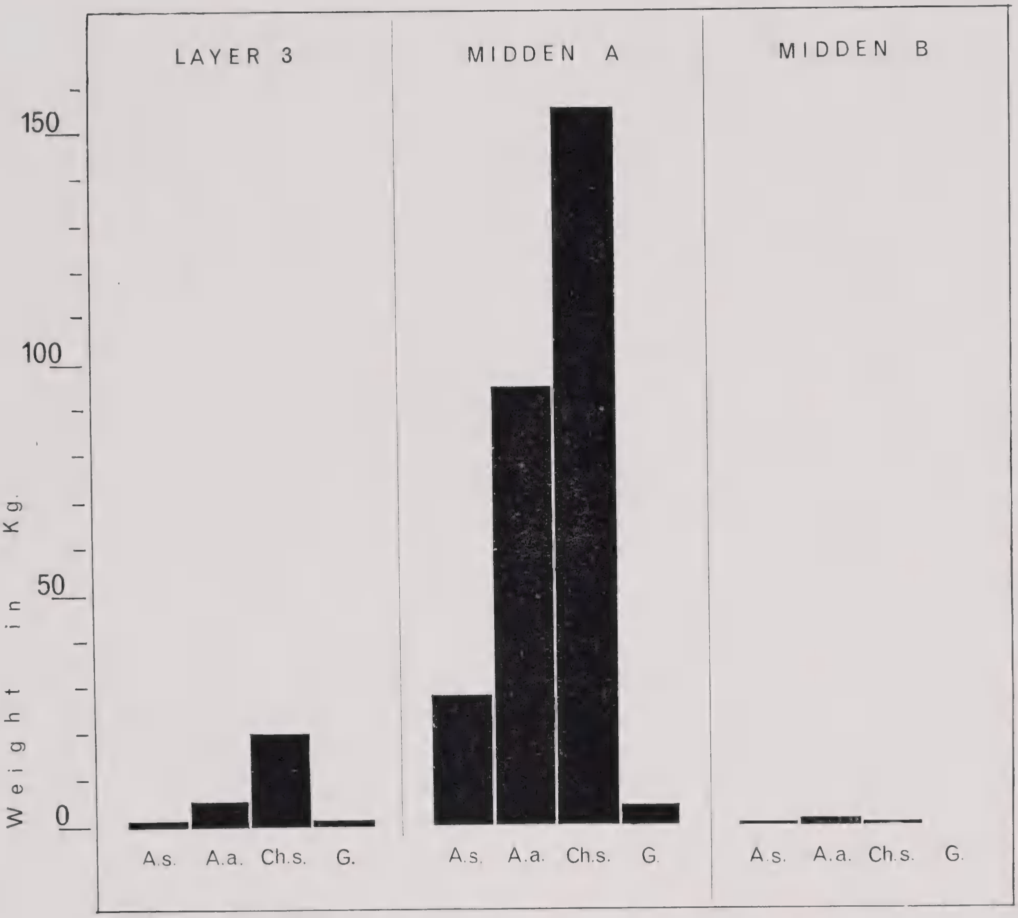


Fig. 14. Species distribution of shell by weight, N49/2.

were frequent, the heavy shells of rock oysters *(Crassostrea glomerata)*, at least, and perhaps of large rock gastropods, would probably have been left on the spot where they were gathered, and thus would not be represented in the midden. The few gastropods and rock oysters present in the midden are probably the result of occasional voyages to the other side of the estuary for fish or fresh water.

The relative scarcity of *Amphidesma subtriangulatum* is rather more difficult to explain, since they are present near the site today in large numbers. Presumably the supplies of estuarine shellfish were adequate to fulfill economic demand, and either because of flavour or easier access were preferred to those of the ocean beach.

Since the later inhabitants of the site almost ignored a rich and readily available source of food in the ocean beach shellfish, there would seem to have been no shortage of protein foods among them. The same was presumably true of the Archaic Maoris, who made almost no use of shellfish for food.

In discussing prehistoric diet in a New Zealand midden site Shawcross, on the basis of modern shellfish samples, estimated the proportion of shellfish meat to shell weight as being approximately 32.5% (Shawcross 1967, p. 121)[1]. Table 2 shows the results of applying this percentage to the Whangamata shellfish.

Table 2. Weights of shellfish.

SHELLFISH		Shell Weight (g)	Calculated Meat Weight (g)	Percent
Layer 3	*Amphidesma australe*	3984	1295	16
	A. subtriangulatum	636	207	2
	Chione stutchburyi	19495	6336	79
	gastropods	683	222	3
	Total	24798	8060	100
Midden A	*Amphidesma australe*	91820	29842	34
	A. subtriangulatum	27147	8823	10
	Chione stutchburyi	147550	47955	54
	gastropods	4723	1535	2
	Total	271240	88155	100
Midden B	*Amphidesma australe*	1055	343	63
	A. subtriangulatum	431	140	26
	Chione stutchburyi	191	62	10
	gastropods	0	0	0
	Total	1677	545	100
Total meat weight of shellfish on site			96.76 kg	

BONE

Fish

Surprisingly (since Whangamata today lies near a good fishing ground) there were few fish bones found in the midden—a total of 30 bones representing a minimum number of six fish. They consisted of the following species.

Snapper *(Chrysophrys auratus)*	3 individuals
Trevalli *(Usacaranx lutescens)*	1
Porae *(Cheilodactylus douglasi)*	1
Unidentified	1

All these came from Midden B; there were no fish bones in the upper layers. The approximate weight of the fish was calculated according to the following formula (for derivation see Shawcross 1967, Allo 1970b).

lx = dentary length (midden material)
Lx = unknown length of fish (midden material)
ls = dentary length (comparative material)
Ls = known length of fish (comparative material)

[1] Properly applicable only to *Amphidesma australe*, but differences in proportion of meat weight in *Chione stutchburyi* and *Amphidesma subtriangulatum* are probably not great.

$$(Lx)^{2.69}/(Ls)^{2.69} = (Wx)/(Ws)$$
$$\therefore Wx = (Ws.lx^{2.69})/(ls^{2.69})$$
$$\therefore Wx = Ws(lx/ls)^{2.69}$$

Using this formula, the combined weight of the trevalli and snapper was calculated to be *ca.* 5.36 kg. The weight of the porae could not be calculated, since the dentary was not present in the midden. A porae of average size in the comparative collection, however, weighed 2.1 kg. The unidentified fish, which appeared to be of approximately the same size, was assumed to be approximately the same weight. A rough estimate of the total weight of fish in Midden B therefore is 9.56 kg. If it is assumed that 90% of this total was edible meat (the Maori probably ate the guts of the fish, cf. Shawcross 1967) the bones from the midden appear to represent a total edible fish meat weight of 8.6 kg.

Bird

Seven species of bird were found in Midden B. These were mostly sea birds, but one example each of the bush-dwelling kiwi and tui were also found. No bird bones were found in Midden A. The distribution of species and minimum number of each present were as follows.

Moa (juvenile, probably *Euryapteryx gravis*)	1
Shag	3
Duck	1
Kiwi	1
Tui	1
White Heron	1
Blue Penguin	1

An attempt was made to estimate the amount of edible meat represented by the bird bones in the midden, using the live weights of birds of approximately the same size (White 1953, weights converted to kilograms). Results are given in Table 3.

Table 3. Weights of birds in Midden B.

SPECIES	EQUIVALENT (White 1953)	No. of individuals	Live weight (kg)	% edible meat	Weight edible meat (kg)
Shag	small goose	3	6.75	70	4.72
Duck	small wood duck	1	0.68	70	0.48
Kiwi	small goose	1	2.25	60	1.35
Tui	woodcock	1	0.21	70	0.15
White heron	small goose	1	2.25	70	1.57
Blue penguin	small wood duck	1	0.68	60	0.41
Juvenile moa	trumpeter swan	1	25.00	60	15.00

Live weights therefore total approximately 37.82 kg. White has estimated that 70% of a live bird's weight consists of edible meat. This proportion, however, does not apply to flightless birds, such as the penguin or moa, whose bones are proportionately heavier. It can be estimated that *ca.* 60% of the live weight of a flightless bird consists of edible meat. The total amount of edible meat represented by the bones from the midden, therefore, is approximately 23.68 kg.

Dog

There were 172 dog bones in the Archaic layer, representing a minimum number of 17 dogs. A further seven bones, probably belonging to a single dog, were found in Midden A.

The bones were lying thickly in a fairly limited area, and scattered among them were obsidian flakes, including a cache of 49 flakes and 3 cores. It is likely that there was some functional connection between the flakes and the dog bones, since 171 minute chips, indicating use or re-chipping of flakes on the spot, were found scattered over this area. The flakes may have been used for butchering the dogs (although there were only a few signs of cutting on the bones) or for the removal or preparation of skins. A large proportion of the flakes showed signs of wear on one or more cutting edge.

There were no pathological abnormalities evident in the bones, and only a few congenital abnormalities, mostly dental. Two right mandibles contained a supernumerary alveolus behind the third molar, indicating either that M_3 had an additional tooth root, or that there was a small single-rooted M_4. This is a fairly common dental abnormality in the Maori dog, being found in at least twelve other sites scattered all over New Zealand, including one site (Native Island) at Stewart Island.

The feature of additional alveoli (usually found behind the last molar, but sometimes also among the premolars) is in fact peculiar to the Maori dog. Crawford, for example, in his study of modern dog dentition (1937, p. 216), wrote:

> "In the dolichocephalic breeds it might be expected that there would be more supernumerary teeth because of the greater length of the jaws. This has not been the case in our observations. Rather the teeth are more widely spaced with exposed gums between, especially in the pre-molars. The dental formula for this type apparently runs true to form."

It must be emphasised that the presence of supernumerary teeth is not a normal feature of Maori dog dentition (it was found in only 7% of North Island Archaic mandibles, and less than 1% of South Island Archaic mandibles) but where it is found on a site it is usually relatively common — 38% of the 18 Redcliffs mandibles possessed a supernumerary M_3 alveolus, for example, as did 43% of those from Jacksons Bay. The Whangamata percentage of mandibles with supernumerary alveoli (only 5%) was unusually low.

Two other mandibles were congenitally abnormal. A left mandible possessed a small single-rooted P_4 (the fourth lower premolar usually has two roots) and in another mandible fusion of the two roots of M_2 into a single tooth root had taken place.

There was also a congenital abnormality present in the body skeleton. Three out of sixteen humeri (one left and two right) lacked a supratrochlear foramen: a thin layer of bone lay between the olecranon and coronoid fossae. This feature is uncommon in the Maori dog: a single example was found at both Heaphy River and Wairau Bar, but these are the only other examples known. Its rarity implies that it is acquired during life (for example as a result of lack of exercise) rather than genetically transmitted. It is common in several breeds of modern dog, and does not involve functional disability.

In a study of the Maori dog (Allo 1970a) it was found that throughout New Zealand prehistory the dog was important as a food animal. Out of a minimum number of 335 dogs from sites all over New Zealand, only two were found articulated and nearly complete. The rest of the bones were widely scattered over the sites, indicating that they were dismembered for eating. The removal of the posterior part of the cranium, presumably for the extraction of the brain for eating, was a common feature on all sites, being found in 169 out of 204 crania (83%). The skull of the dog is very strong, and unlikely to split cleanly in half across the parietals by accident, especially since the breakage did not follow a cranial suture. On some skulls there was even a clear indication of a heavy blow, probably made by a stone, on the supraoccipital or right parietal. The relatively few cuts found on the bones indicate that the dog was cooked whole rather than dismembered immediately after slaughtering. A few bones, both at Whangamata and at other sites, do bear shallow cuts. These cuts, nearly always on the long bones, may have been made in butchering the animal, or as a preliminary stage in manufacturing a bone artifact.

Only a few bones at Whangamata were carbonised. Since the Maori in both Archaic and Classic phases, used the *haangi* or earth oven where the food is cooked by hot stones and never comes into direct contact with fire, the burning of the bones is probably not a result of cooking, but is accidental.

The archaeological evidence that most Maori dogs were eaten after death is well supported by ethnographic evidence. There are several descriptions of the dog as a food animal. Crozet, for instance, who gave one of the first descriptions of the Maori dog, wrote in 1772 (Crozet 1891): "It appears that the savages only raise them (dogs) for food." The elder Forster in 1778 commented (Forster 1778 p. 189): "They (dogs) are kept by the natives chiefly for the sake of their flesh, of which they are very fond, preferring it to pork."

It is a reasonable assumption, then, that the Whangamata dogs (none of which was found articulated) were used as food animals. It is interesting to define the economic importance of the dog in this site as a source of food.

Of the 17 individuals found, four were juveniles aged less than seven months. It was possible, by a study of their dentition, to date the juveniles accurately: the youngest was aged approximately 5 months, two were aged 5 to 6 months, and the fourth died at the age of 6 to 7 months. The remaining dogs probably died when they were over 18 months old (only 9 bones with unfused epiphyses were found, representing a minimum of 4 individuals less than 18 months old).

By comparing the average condylo-symphisis length of the left mandible, the most frequent intact bone of the Whangamata dogs, with that of a comparative collection of known weight and size, it was possible to compute the approximate body weight of the Maori dogs.

Since the Maori dog had disproportionately short legs in relation to head size, the calculated weight is probably slightly too large. However most of the weight of an animal is distributed in the head and trunk rather than in the limbs, and disparity should not be too great. The dogs of the comparative collection on which weight estimates were based were all rather thin, as probably was the Maori dog.

In computing body weight, the following formula was used, based on an assumed increase in body weight proportionate to the cube of a linear increase in body size.

If W = known weight of comparative material

And Ws = unknown weight of sample

And if L = average length of mandible of comparative material

And Ls = average length of mandible of sample

$$\text{Then } Ws = \frac{W \times Ls^3}{L^3}$$

Using this formula, the average weight of the adult Whangamata dogs was 12.65 kg. The average weight of the juveniles was estimated to be four-fifths of this total or 10.11 kg. The total weight of the dogs at death came to approximately 204.98 kg.

Obviously this weight is far greater than the weight of the edible meat. In his study of the utilisation of food animals by prehistoric peoples, Theodore White has estimated that 50% of the live weight of fox, coyote and wolf was usable meat. If this proportion is accepted for the Maori dog, then the skeletal remains at Whangamata represent approximately 102.5 kg of dog meat.

HUMAN

Burnt and scattered human bones, representing a single individual, were found scattered among the dog bones of the Archaic layer, and are probably evidence of cannibalism.

The bones were those of an adult, but were so fragmented it was impossible to estimate sex or size. If it is assumed that the individual weighed *ca.* 63.5 kg (10 stone), and that, as with dog, deer and bison, 50% of the total weight of the human animal consists of edible meat, then the single skeleton represents approximately 31.7 kg of meat.

Table 4. Weights of mammals other than dog, man and whale.

	ANIMAL	Average live weight (kg)	% edible meat	Weight edible meat (kg)
Midden A	Rat	0.35	70	0.24
	Rabbit	1.58	50	0.79
	Fur Seal	180.00	70	126.00
	Total			127.03
Midden B	Fur seal (2)	360.00	70	252.00

OTHER

Bones representing a minimum number of two seals (probably the Southern Fur Seal) were found in the Archaic layer, as was the vertebra of a whale. A single seal bone, the ulna of a rabbit, bones of a *kiore* (native rat) and pieces of whale rib were found in Midden A. The total live weight and amount of edible meat represented by these bones is given in Table 4 (the whale(s) omitted).

Conclusions

Since only twenty-eight square metres were excavated in a site of unknown extent, any conclusions must of course be tentative. However it seems that two

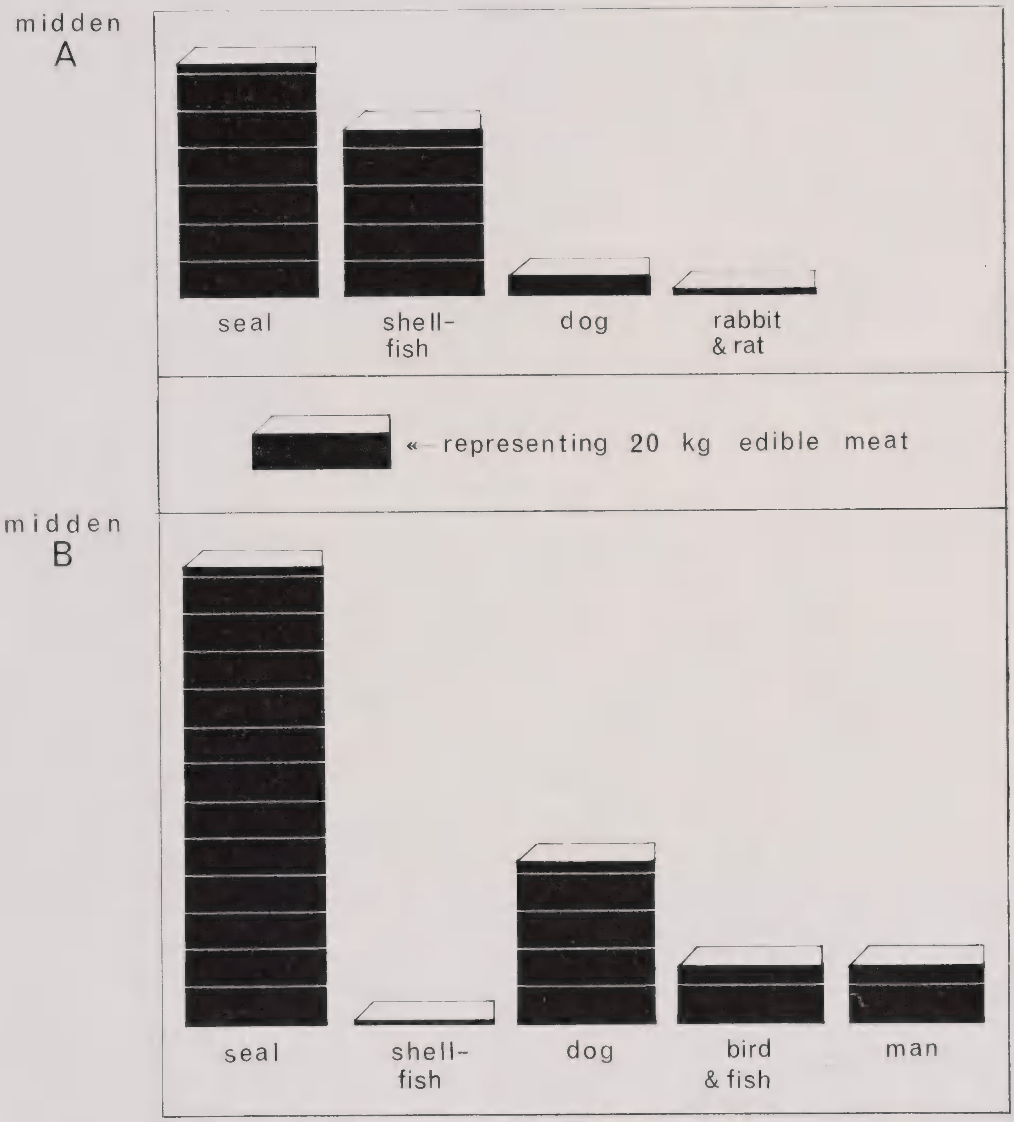


Fig. 15. Calculated meat weights, Middens A and B, N49/2.

main occupation periods are represented at the Whangamata wharf site, during which widely different use was made of available food resources. These differences are illustrated in Figure 15.

During the Archaic phase (Midden B) the inhabitants of the site almost ignored the readily available supplies of shellfish, and instead obtained their protein mainly from seal and dog. The absence of shellfish in Archaic middens is a common phenomenon in New Zealand (e.g. Lockerbie 1959) and it has been postulated that the Maori only turned to marine sources of food as a result of the extermination of the moa (Lockerbie 1959, Simmons 1969). At Whangamata moa would seem to have been relatively unimportant; seal and dog were the major protein foods. It may be that an increasing dependence on shellfish foods in many areas during the Classic phase was due to a complex of causes rather than simply to scarcity of moa.

The dog seems to have been a major food animal during the Archaic phase of Whangamata. This contrasts with observations from early explorers in New Zealand that the dog was a rare and much prized delicacy (e.g. Forster 1778, p. 208; Cruise 1824, p.270) and with archaeological evidence that the dog was comparatively rare during the Classic Maori phase (Allo 1970a, chapter 5).

The more recent occupation levels of Whangamata (Midden A and Layer 3) seem to represent a transition between the traditional and European ways of life. Maori artifacts (obsidian flakes, whalebone tabs and an adze) were found intermingled with European goods in Midden A, apparently dating from the latter half of the nineteenth century, and Layer 3 is probably fairly closely related in time. Shellfish were the major source of food; in contrast to the Archaic period, no use was made of fish or bird resources and only one dog was found in the midden.

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